

1. (Amended) A process for applying a metal to a microelectronic workpiece, the microelectronic workpiece including an exteriorly disposed surface having a plurality of micro-recessed structures that are defined by sidewalls, the microelectronic workpiece further including a barrier layer deposited on at least a portion of the exteriorly disposed surface of the microelectronic workpiece and on at least substantial portions of the walls of the plurality of micro-recessed structures, the process comprising the steps of:

- (a) forming an ultra-thin metal seed layer exterior to the barrier layer using a first deposition process, the seed layer having a thickness of less than or equal to about 500 Angstroms;
- (b) [enhancing] repairing the ultra-thin seed layer by depositing an additional metal using a second deposition process that is different from the first deposition process to provide [an enhanced] a repaired seed layer that is suitable for subsequent electroplating, the [enhanced] repaired seed layer having a thickness at all points on sidewalls of substantially all micro-recessed structures distributed within the workpiece that is equal to or greater than about 10% of the nominal thickness of the enhanced seed layer over the exteriorly disposed surface of the workpiece [.];
- (c) electroplating a metal onto the repaired seed layer using a third deposition process using processing parameters that are different from processing parameters used in the second deposition process.

14. (Amended) The process of claim 4 [and further comprising the step of subjecting the microelectronic workpiece to a further electrochemical] wherein the third deposition process

takes place in an acidic electrolytic solution to [complete deposition of a] the metal to at least a thickness needed to substantially fill the micro-recessed structures.

16. (Amended) In a manufacturing line including a plurality of apparatus for the manufacture of micro-sized metal structures on a microelectronic workpiece, one or more apparatus of the plurality of apparatus being used for applying metal to a surface of [a] the microelectronic workpiece, the one or more apparatus comprising:

means for applying a conductive ultra-thin seed layer to a surface of the microelectronic workpiece using a first deposition process, the ultra-thin seed layer having a thickness of less than 500 Angstroms;

means for electrochemically [enhancing] repairing the conductive ultra-thin seed layer using a second deposition process that differs from the first deposition process to thereby provide [an enhanced] repaired seed layer that is suitable for subsequent [electrochemical deposition] electroplating;

means for electroplating [of the] a metal onto the repaired seed layer to a predetermined thickness representing a bulk portion of the micro-sized metal structure.

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27. (Amended) One or more apparatus as claimed in claim 20 [and further comprising means for electrochemically adding a further layer of] wherein said means for electroplating comprises means for electroplating copper over the [resulting enhanced] repaired seed layer by [electrochemically depositing copper] using an acidic copper bath.

30. (Amended) A process for applying a metal to a surface of a microelectronic workpiece pursuant to forming one or more micro-sized metal structures thereon, the microelectronic workpiece including a barrier layer deposited on at least a portion of the surface of the microelectronic workpiece, the process comprising the steps of:

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- (a) forming an ultra-thin metal seed layer on the barrier layer, the ultra-thin metal seed layer having a thickness of less than 500 Angstroms;
 - (b) subjecting the microelectronic workpiece to [an] a first electrochemical copper deposition process in an alkaline electrolytic bath having copper ions complexed with a complexing agent such that additional copper is deposited on the ultra-thin metal seed layer to [thereby form an enhanced] repair the seed layer so that is suitable for subsequent electrochemical deposition;
 - (c) subjecting the microelectronic workpiece to a second electrochemical copper deposition process using processing parameters that differ from processing parameters used in the first electrochemical copper deposition process.

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43. (Amended) The process of claim 30 wherein the complexing agent is comprised of citric acid.

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45. (Amended) The process of claim 30 [and further comprising the step of subjecting the microelectronic workpiece to a further] wherein the second electrochemical copper deposition process takes place in an acidic electrolytic solution to complete deposition of the copper to a thickness needed for the formation of the micro-sized metal structure.

b7C ent 46. (Amended) The process of claim 45 and further comprising the step of subjecting the microelectronic workpiece to a rinsing process after step (b) and prior to the [further] second electrochemical copper deposition process in the acidic electrolytic solution.

47 49. (Amended) A process for applying a metal to a microelectronic workpiece pursuant to forming a micro-sized metal structure on a surface of the microelectronic workpiece, the process comprising:

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- (a) forming [an ultra-thin] a metal seed layer on a surface of the workpiece using a first deposition process, [the ultra-thin seed layer having a thickness of less than 500 Angstroms] the metal seed layer being generally unsuitable for bulk deposition of a metal that is to be used to form the micro-sized metal structure;
 - (b) [enhancing the ultra-thin] repairing the seed layer by depositing [an] additional metal [layer] on the [ultra-thin metal] seed layer using a second deposition process that differs from the first deposition process to thereby provide [an enhanced] a repaired seed layer that is suitable for subsequent [electroplating] bulk deposition of a metal that is to be used to form the micro-sized metal structure;
 - (c) subjecting the microelectronic workpiece to a third deposition process using processing parameters that differ from processing parameters used in the second deposition process to deposit a bulk amount of the metal that is used to form the micro-sized metal structure.

48 50. (Amended) The process of claim ~~49~~ ⁴⁷ wherein the [ultra-thin] metal layer formed in step (a) has a thickness of about 100 to about 250 Angstroms.

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51. (Amended) The process of claim 49 wherein the [ultra-thin] metal seed layer of step (a) is formed in a physical vapor deposition process.

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52. (Amended) The process of claim 49 wherein the [ultra-thin] metal seed layer of step (a) is formed in a chemical vapor deposition process.

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53. (Amended) The process of claim 49 wherein the [ultra-thin] seed layer is enhanced in step (b) by electrochemically depositing the additional metal layer.

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54. (Amended) The process of claim 52 wherein the microelectronic workpiece comprises a barrier layer on which the [ultra-thin] seed layer is formed and wherein the additional metal layer is electrolytically deposited using an alkaline electrolytic plating solution that includes a complexing agent.

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55. (Amended) The process of claim 55 [and further comprising] wherein the third deposition process of step (c) comprises the step of electrolytically depositing [a] the bulk amount of the metal [layer] on the surface of the [enhanced] repaired seed layer in an acidic electrolytic plating solution.

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56. (Amended) The process of claim [54] 56 and further comprising the step of rinsing the microelectronic workpiece after electrolytically [enhancing the ultra-thin] repairing the seed

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layer in the alkaline electrolytic plating solution and prior to subjecting the microelectronic workpiece to the acidic electrolytic plating solution.

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57. (Amended) The process of claim 48 wherein the [ultra-thin] metal seed layer of step (a) is formed in a physical vapor deposition process.

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58. (Amended) The process of claim 48 wherein the [ultra-thin] metal seed layer of step (a) is formed in a chemical vapor deposition process.

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59. (Amended) The process of claim 48 wherein the [ultra-thin] seed layer is enhanced in step (b) by electrochemically depositing the additional metal [layer].

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60. (Amended) The process of claim 51 wherein the microelectronic workpiece comprises a barrier layer on which the [ultra-thin] seed layer is formed and wherein the additional metal [layer] is electrolytically deposited using an alkaline electrolytic plating solution that includes a complexing agent.

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61. (Amended) The process of claim 52 [and further comprising the step of electrolytically depositing a metal layer on the surface of the enhanced seed layer] wherein the deposition of step (c) takes place in an acidic electrolytic plating solution.

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62. (Amended) The process of claim 53 and further comprising the step of rinsing the microelectronic workpiece after electrolytically [enhancing the ultra-thin] repairing the seed

layer in the alkaline electrolytic plating solution and prior to subjecting the microelectronic workpiece to the acidic electrolytic plating solution.

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63. (Amended) In a manufacturing line including a plurality of apparatus for the manufacture of microelectronic circuits or components, one or more apparatus of the plurality of apparatus being used for applying interconnect metallization in a damascene process to a surface of a microelectronic workpiece used to form the microelectronic circuits or components, the one or more apparatus comprising:

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means for applying [an ultra-thin] a metal seed layer to a surface of the [semiconductor] microelectronic workpiece using a physical vapor deposition process, the [ultra-thin] metal seed layer being generally unsuitable for bulk electrochemical deposition of the interconnect metallization [having a thickness less than 500 Angstroms];

means for electrochemically [enhancing the conductive ultra-thin] repairing the metal seed layer to render it suitable for subsequent electrochemical application of a metal to a predetermined thickness representing a bulk portion of the interconnect metallization.

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64. (Amended) A process for applying a metal to a microelectronic workpiece, the process comprising the steps of:

- (a) forming [an ultra-thin] a metal seed layer using a first deposition process, the first deposition process physically anchoring the [ultra-thin] metal seed layer to an underlying layer, the [ultra-thin] metal seed layer having [a thickness that is less than 500 Angstrom]

physical characteristics that render it generally unsuitable for bulk electrolytic deposition of a metal thereon;

- (b) [enhancing] repairing the [ultra-thin] seed layer by electrochemically depositing an additional metal on the [ultra-thin] seed layer using a second deposition process that is different from the first deposition process to form [an enhanced] a repaired seed layer;
- (c) electrolytically depositing a metal on the [enhanced] repaired seed layer under conditions in which the deposition rate of the electrolytic deposition process is substantially greater than the deposition rate of the process used [in enhancing the ultra-thin] to repair the seed layer.

63. (Amended) A process for filling a micro-recessed structure disposed in a surface of a microelectronic workpiece with a metal, the microelectronic workpiece including a barrier layer deposited on at least a portion of the upper surface thereof and on surfaces of the plurality of micro-recessed structures, the process comprising the steps of:

- (a) forming [an ultra-thin] a metal seed layer on the barrier layer using a physical vapor deposition process, the [ultra-thin] metal seed layer having [a thickness that is less than or equal to about 500 Angstroms] physical characteristics that render it generally unsuitable for bulk electrolytic deposition of a metal thereon;
- (b) [enhancing the ultra-thin] repairing the seed layer by electrolytically depositing additional metal on the ultra-thin metal seed layer using an alkaline electroplating solution to thereby form [an enhanced] a repaired seed layer;
- (c) substantially filling the micro-recessed structures with a metal in an electrolytic deposition process using an acidic electroplating solution.

Please add the following as new claims 70-71.

~~70. (New) An apparatus for use in applying interconnect metallization to a surface of a microelectronic workpiece to form microelectronic circuits or components, the apparatus comprising:~~

~~a first processing station including a means for electrochemically repairing a metal seed layer of a microelectronic workpiece received at the first processing station, the metal seed layer of the microelectronic workpiece received at the first processing station being generally unsuitable for bulk electrochemical deposition of the interconnect metallization, the seed layer being repaired at the first processing station to render it suitable for subsequent bulk electrochemical deposition of the interconnect metallization;~~

~~a second processing station disposed to receive the microelectronic workpiece with the repaired metal seed layer, the second processing station including a means for electrochemically depositing a bulk portion of the interconnect metallization on the repaired seed layer.~~

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71. (New) An apparatus for use in applying one or more metal structures to a surface of a microelectronic workpiece, the apparatus comprising:

- a first processing station including a means for electrochemically repairing a metal seed layer of a microelectronic workpiece received at the first processing station, the metal seed layer of the microelectronic workpiece received at the first processing station being generally unsuitable for bulk electrochemical deposition of the one or more metal structures, the seed layer being repaired at the first processing station to render it suitable for subsequent bulk electrochemical deposition of the one or more metal structures;
- a second processing station disposed to receive the microelectronic workpiece with the repaired metal seed layer, the second processing station including a means for electrochemically depositing a bulk portion of the one or more metal structures on the repaired seed layer.

